SCIENCE FOCUS: ETHIOPIA, RED SEA, AND NILE RIVER

Previous *Science Focus!* articles have discussed a particular phenomenon that is visible in SeaWiFS data and imagery. In this case, however, SeaWiFS has provided superb views of a distant region of the world that has many unique geological and physical features. Furthermore, this region of Africa has both archaeological and anthropological significance. Hominid fossils found here indicate that this region may be the origin of humanity's presence on Earth, and the Nile River valley and delta are the home of numerous archaeological sites from the time of the Pharaohs.

The SeaWiFS image below is centered on Ethiopia. The sites that are labeled will be discussed on the following pages. The image without labels appears on page 4.

Starting at the top right, the capital city of Sudan, Khartoum, is located at the convergence of the Blue Nile and the White Nile. Although the Blue Nile is much shorter than the White Nile, it contributes about 80% of the flow of the river.

Moving west, the Dahlak Archipelago is seen off the Red Sea coast of Eritrea. Because of their isolation, the numerous coral reefs of the Dahlak Archipelago are some of the most pristine remaining in the world. Portions of the Dahlak Archipelago are in the Dahlak Marine National Park.

Directly south of the Dahlak Archipelago, in the inhospitable desert region of the Afar Triangle and the Danakil Depression, is the active shield volcano Erta Ale. The summit crater of Erta Ale holds an active lava lake.

South of Erta Ale, the terminal delta of the Awash River can be seen. The Awash River begins in the East African Rift Valley and flows into the Afar Triangle, but the waters of the Awash never reach the Red Sea. Instead, they spread out and evaporate in the Danakil Depression.

The East African Rift valley is an example of an active divergent rift valley, one of the few areas on Earth where a continent is being actively separated (rifted) by the ongoing forces of plate tectonics. The actual profile of the valley is a nearly exact match to the profile of the central axis of mid-ocean ridges. The East African Rift valley connects to the seafloor of the Red Sea. The central depths of the Red Sea are also the site of active tectonic movement, as the African Plate slowly separates from the Arabian Plate. At the bottom of the Red Sea, Earth's inner heat creates hot pools of brine (extremely salty water) that give rise to exotic copper, zinc, manganese, and iron minerals.

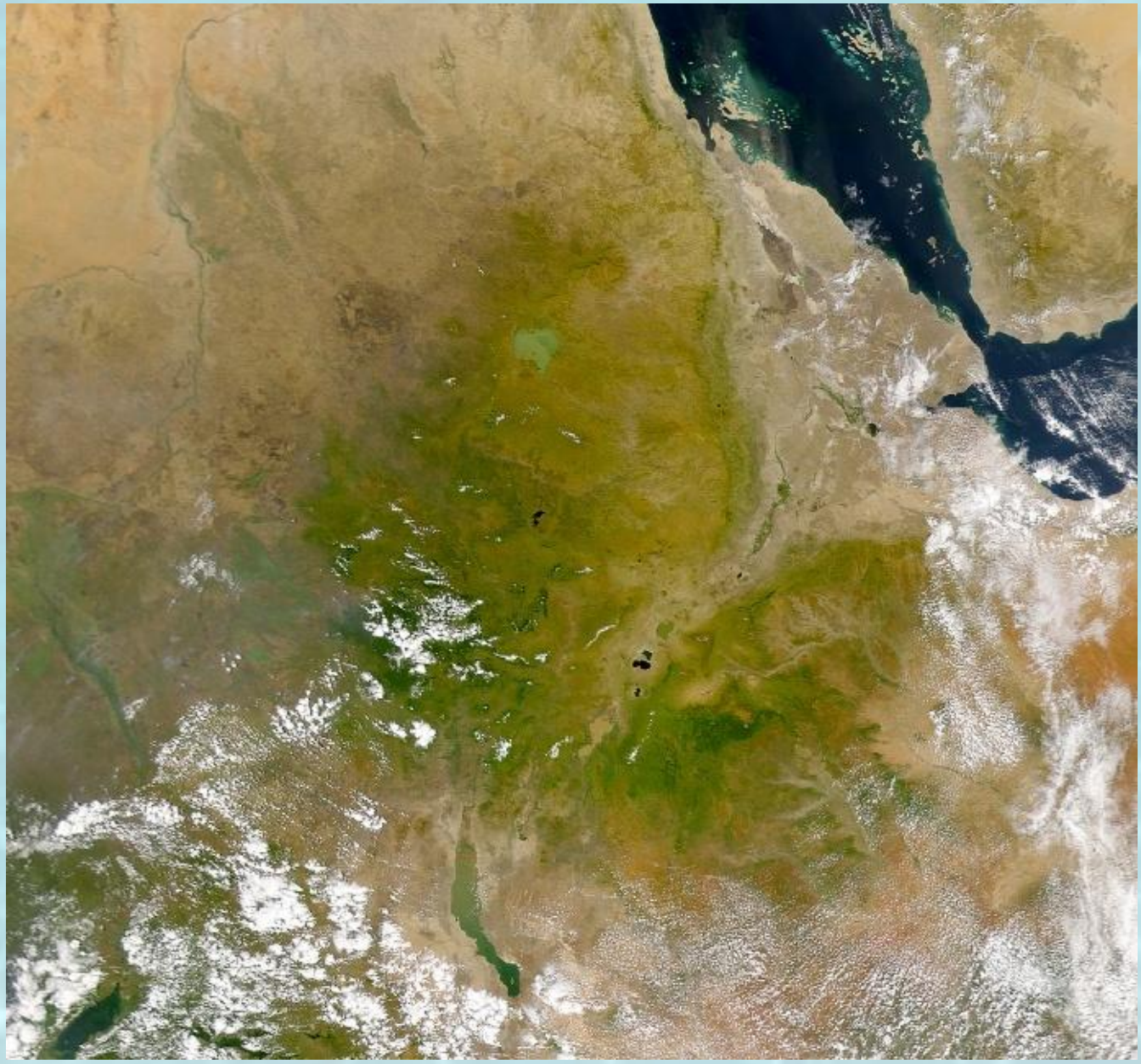
North of the Rift Valley, in central Ethiopia, are the Simien Mountains and Lake Tana. Lake Tana is the source of the Blue Nile. Just a few miles south of the lake is Tississat, "Water That Smokes", also called Blue Nile Falls. The Simien Mountains feature the highest point in Ethiopia, Ras Dejen. Simien Mountains National Park is a UNESCO human heritage site.

In the lower left corner of the image is Lake Albert, located on the border of Uganda and the Democratic Republic of the Congo (formerly Zaire). Lake Albert lies in the western branch of the African Rift Valley.

The final region that is labeled in this image is Omo National Park and Lake Turkana. Several specimens of early hominid fossils, particularly australopithecines, the likely ancestors of modern *Homo sapiens*, have been found here, as well as at Hadar and the Middle Awash River sites in the Afar Triangle. The famous "Lucy" skeleton, an example of *Australopithecus afarensis*, was found in the Hadar area. Early specimens of genus *Homo*, including *Homo habilis* and *Homo erectus*, were also found in the Omo River/Lake Turkana region.

Some anthropologists speculate that one reason the East Rift Valley was where human beings originated was the ongoing geological rifting process in the area. They believe that this process led to considerable ecological stress and disruption, a situation that favors rapid evolution and even the development of intelligence. The distribution of fossils in various parts of the Rift Valley makes this theory difficult to confirm, as the global climate was also undergoing fairly rapid climate change. The climate in this African region was clearly becoming cooler and drier, leading to changes in vegetation cover from forests to grasslands and expansion of deserts. One of the primary changes that may have occurred in the early hominids was the development of the ability to walk, perhaps due to the loss of forest cover and the expansion of grasslands. At Laetoli in northern Tanzania, just south of the southern margin of this image, footprints in hardened volcanic ash, presumably made by australopithecines, were discovered.

Southern Red Sea, Ethiopia and northern Rift Valley of Africa



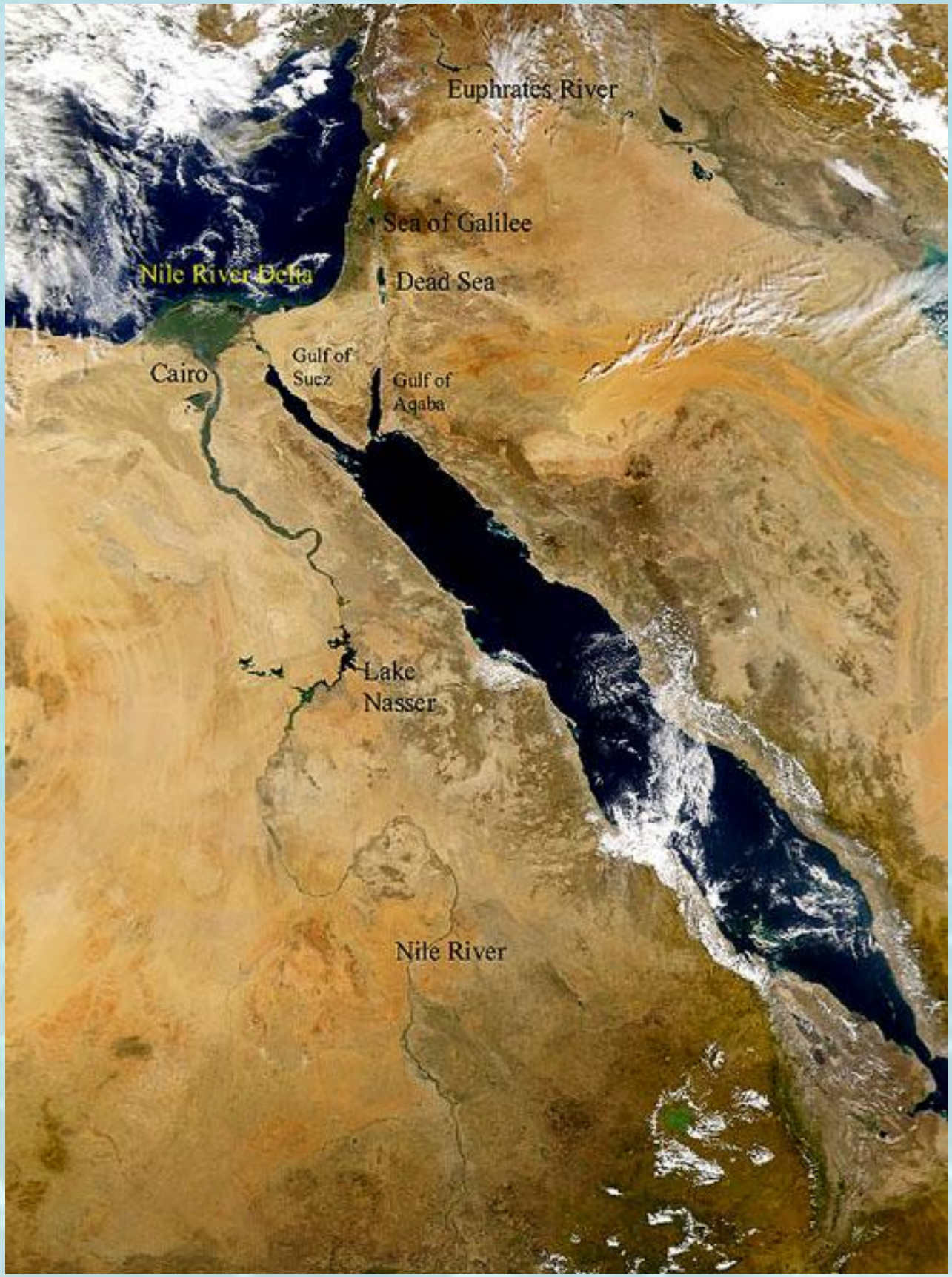
In the image of the Red Sea and Nile River shown on the next page, several features are also labeled. The delta of the Nile River is prominent on the coast of the Mediterranean Sea, above Cairo, Egypt. The fertility of the Nile Delta and the banks of the Nile River provided stable agriculture for the Egyptian civilization of the Pyramids and the Pharoahs. To the south of the broad green Nile River valley is the dark water of Lake Nasser, formed by the Aswan High Dam. The reduction of sediments in the Nile north of the river, due to trapping of the sediments in Lake Nasser behind the Aswan dam, is one reason that the Nile River delta is slowly sinking. Two gulfs, the Gulf of Suez and the Gulf of Aqaba, form a Y-shape at the northern end of the Red Sea. The Gulf of Suez, which goes north to the Suez Canal, is the eastern gulf and is only 60-70 meters deep. The Gulf of Aqaba, in contrast, is an extension of the Red Sea rift zone, and is approximately 1800 meters deep. The rift continues north to the Dead Sea and the Jordan River valley.

This image of the Middle East displays both the longest major river in the world, the Nile (6,670 km), and also one of the shortest, the Jordan (320 km), which flows south from the Sea of Galilee to the Dead Sea. The approximate annual volume of water delivered by the Jordan River to the Dead Sea is 1.85×10^9 cubic meters, about 2% of the annual volume of water flowing in the Nile, 9.45×10^{10} cubic meters.

The image also shows two rivers that flow into terminal basins: the Awash, which ends in the terminal delta in the Afar Triangle, and the Jordan, which terminates at the Dead Sea.

Near the top of the image, another river that was prominent in the early history of human civilization, the Euphrates River, can be seen.

An unlabeled image is shown on page 7.


Euphrates River
Sea of Galilee
Nile River Delta
Dead Sea
Cairo
Gulf of Suez
Gulf of Aqaba
Lake Nasser
Nile River